Evolution of Low-level Flow Patterns in Littoral Regions When Extratropical Marine Cyclones Encounter Coastal Mountains

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Award Number: N0001400WR20018

LONG-TERM GOALS

The long term goal of this project is to understand the interaction of slightly different large scale flows interaction with complex coastal topography to produce both regions of enhanced and diminished near surface winds.

OBJECTIVES

The objectives of this study are to utilize mesoscale and enhanced synoptic scale observations from the California Land-falling Jets Experiment (CALJET) to define the mesoscale wind fields in complex coastal topography. These mesoscale wind fields will be related to critical parameters in the incident flow to determine when sheltering and enhancement of local winds occurs. The ability of mesoscale models to capture this interaction will also be examined.

APPROACH

The basic approach used in this study is to utilize local mesoscale observations to define the local wind response near coastal mountains and to relate these responses to incident flow characteristics and to the accuracy of mesoscale model forecasts. This will be done for cases that occurred during the CALJET experiment in order to provide a range of synoptically similar but slightly different incident flow situations.

WORK COMPLETED

Synoptic-scale analyses from NOGAPS have been used to characterize the incident flow through the CALJET period as it interacts with the California coastline near Monterey. This synoptic characterization has been used to determine the flow direction, speed, and stratification for multiple

Report Documentation Page

Form Approved
OMB No. 0704-0188

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1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
SEP 2000		

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Evolution of Low-level Flow Patterns in Littoral Regions When Extratropical Marine Cyclones Encounter Coastal Mountains	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Department of Meteorology, Code Mr/Nu,,Naval Postgraduate School,589 Dyer Rd. Root Hall 254,,Monterey,,CA,93943**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited.

13. SUPPLEMENTARY NOTES
The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**		**3**	

events during the winter of 1998. Mesoscale observations for the Monterey Bay region have been assembled for these cases in order to perform mesoscale analyses to characterize the flow response to topography. The three dimensional multiquadric analysis code has been completed and thoroughly tested in order to complete these analyses. This analysis code is being used routinely to produce local mesoscale analyses in real time. These are available on the web at http://www.weather.nps.navy.mil/wx/latest_anal.html and are being used to routinely characterize the mesoscale circulations in the Monterey region.

RESULTS

The primary results to date have been the development of reliable analysis software and the characterization of the synoptic-scale evolution of several events during the CALJET period. One case, Feb. 5, has been analyzed more completely and it shows evidence channeling and flow sheltering in the lee of topography. These effects seem to be time dependent as a front approaches with the most prevalent interaction occurring with increased pre-frontal stratification. The threshold for these effects is being determined for this case and will be extended to other cases to better apply basic theories of topographic flow interaction to arbitrary flows in complex topography. The analysis software to perform mesoscale analyses is working very well and routinely shows mesoscale eddies and other topographic effects in the real-time analyses for the Monterey Bay region. Application to the historical data for the CALJET period should provide adequate definition of flow interaction effects. Quality control of the mesoscale data has been partially completed and has been found to be essential to provide accurate mesoscale analyses.

IMPACT/APPLICATION

The impact of these studies will be in furthering our basic understanding of flow interaction with coastal mountains and will aid Navy forecasters in assessing the accuracy of mesoscale model forecasts of coastal winds.

TRANSITIONS

These results have been used as classroom examples at the Naval Postgraduate School.

RELATED PROJECTS

The ONR-sponsored project by the same investigators, entitled “Dependence of mesoscale coastal predictability on sampling and data assimilation” is closely related and utilizes some of the same cases for fundamental predictability studies.